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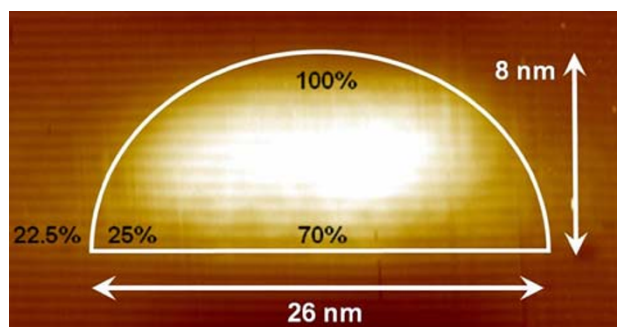
NANO SPOTLIGHTS

Ellipsoidal InAs Quantum Dots

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Uses of semiconductor quantum dots (QDs) have been explored for attractive applications such as quantum information processing, lasers and solar cells to name a few. However, their ability to become integrated with existing technologies depends on shape, composition and size, all of which play a role in modifying both the optical and electrical properties of the QDs. However, an in-depth understanding of the structure-property relationship of QDs is still lacking. In an effort to expand the understanding of this relationship, scientists from the Radboud University Nijmegen (The Netherlands), Eindhoven University of Technology (The Netherlands) and the Ruhr-Universität in Bochum (Germany) have employed the use of cross-sectional scanning tunneling microscopy (X-STM), a technique perfected by Paul Koenraad's group at the COBRA Inter-University Research Institute in Eindhoven, to investigate and determine the structural composition of InAs QDs. The results of the work entitled, "*Ellipsoidal InAs quantum dots observed by cross-sectional scanning tunneling microscopy*" was published in Applied Physics Letters.

"We were surprised to find that the shape and composition deviate strongly from those which are usually used", says Janneke Blokland, PhD student at the Nijmegen High Field Magnet Laboratory (HFML) and first author of the paper. "The dots have an ellipsoidal shape and turned out to be much taller and with a stronger indium gradient than expected". The report was very interesting since both the optical and electrical properties of the ellipsoidal QDs were earlier determined and reported in a Physical Review B paper "*Hole levels in InAs self-assembled quantum dots*". "This is the first time that structural and spectroscopic



Size, shape and composition of an In(Ga)As quantum dot. The percentages indicate the fraction of InAs, and reveals that it increases vertically from 70% at the base center to 100% at the top center. In addition, horizontally the fraction InAs decreases to 25% at the base edge, evolving in a 22.5% 7 monolayer thick wetting layer. The solid line depicts the ellipsoidal shape of the QD

properties of quantum dots are experimentally combined", says Peter Christianen, associate professor at the HFML Nijmegen. According to Christianen, spectroscopic data was only recently explained by theoretical models with the use of the QD dimension and composition as fitting parameters. "These simple models resulted in dot parameters that are really different than the ones we have found now" explains Christianen to Nanospotlight. "With our unique combination of spectroscopy and X-STM experiments on the same QDs, we make it possible to really test advanced theoretical models to understand the underlying physics at the nanoscale and use this knowledge to improve the performance of future devices".

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